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**SERIES Q,
CONVECTIVE LAMP HOUSING**

MODEL 60000

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I

INTRODUCTION

The 60000 Series Q is a modular, convectively cooled lamp housing with four output ports. The lamp base has external knobs to allow lamp position adjustment during operation in X, Y, and Z directions.

Since the product is fanless, and accommodates light sources up to 150 W, the exterior has been designed with cooling fins to reduce heat through natural convection.

The 60000 accommodates 14 light sources with 18 mounting arrangements. The housing can be converted by the user to operate arc lamps, tungsten halogen, deuterium and IR sources. Table 1 on the following page and Fig. 1 on page 6 shows the appropriate interface kit and socket adapter for each lamp. Complete Series Q Housings with a choice of lamp (and mount) are available. See Volume II for specific configurations.

A number of accessories can be used in conjunction with the Series Q. One or more adjustable reflectors can be mounted on the output ports to maximize light output. Similarly, lens assemblies to collimate or image can be used. Fig. 2 on page 7 shows the various configurations.

Table 1 Appropriate Interface Kits and Socket Adapters for 60000 Series Q Housing

Lamp		Interface Kit	Socket Adapter	Basic Power Supply	Fully Featured Power Supply	Ignitor
Type	Model No.					
Arc Lamps						
75 W Xe	6251	60010	60014	68806*	68805**	68705
75 W Xe OF	6263	60010	60014	68806*	68805**	68705
50 W Hg	6282	60010	60013	68806*	68805**	68705 or 68709
100 W Hg	6281	60010	60012	68806*	68805**	68705 or 68709
Quartz Tungsten Halogen Lamps						
10 W	6318	60020	60042 H 60045 V	68735	68830	
20 W	6319	60020	60042 H 60045 V	68735	68830	
50 W Short Filament	6332	60020	60043 H 60046 V	68735	68830	
50 W Long Filament	6337	60020	60046 V	68735	68830	
100 W	6333	60020	60043 H 60046 V	68735	68830	
IR Elements						
IR Emitter	6363	60020	60041	68735	68830	
Ceramic Element	6575	60020	60048		68830	
Deuterium Lamps						
30 W	6316	60023	Not Required		68840	
30 W High Irradiance	63162	60023			68840	
30 W High Radiance	63163	60023			68840	

(H) Lamp mounted horizontally

(V) Lamp mounted vertically

* Has built-in ignitor.

**Requires stand alone ignitor.

MODEL 60000 Q - HOUSING CONFIGURATION
LIGHT SOURCE AND ADAPTER OVERVIEW

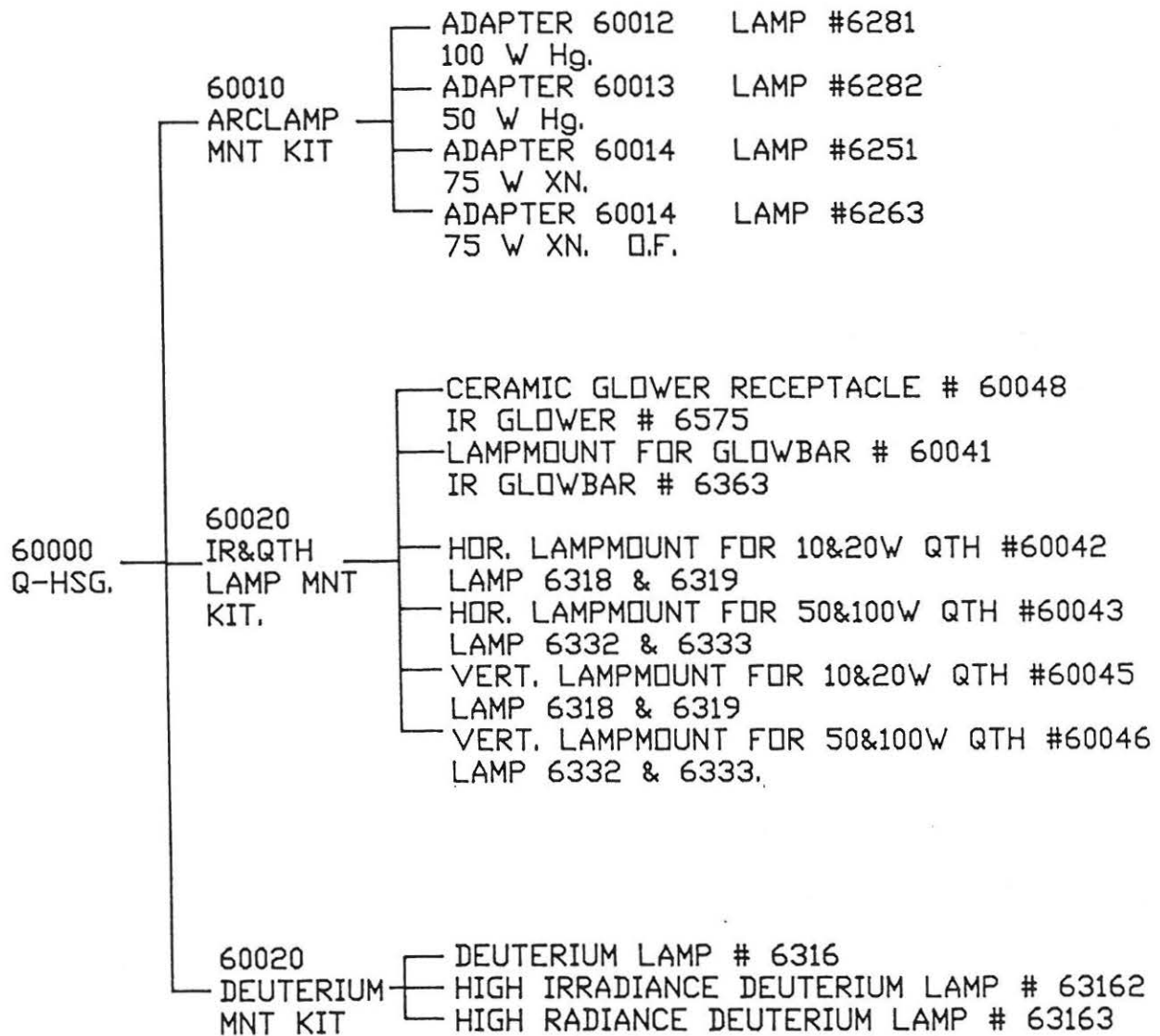


Fig. 1 Series Q Lamp Housing Interface Kits and Socket Adapters.

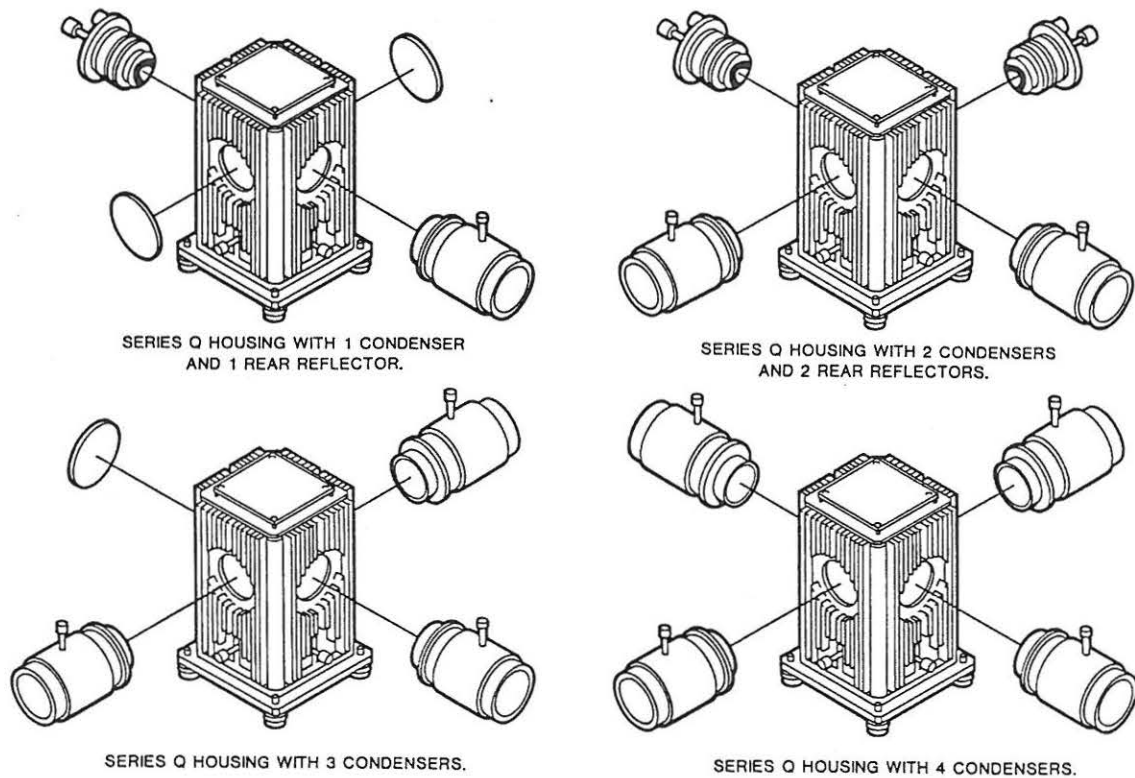


Fig. 2 Various configurations of Series Q Housing.

II

SAFETY CONSIDERATIONS

There are six hazards in the operation of the 60000 Series Q Lamp Housing. They are:

- Radiation
- Lamp explosion
- Ozone
- Electrical shock
- EMI
- Heat

II.1 RADIATION

The high intensity UV and VIS radiation of some lamps can permanently damage the cornea, lens, and retina of the eye, even causing blindness. This damage may not be immediately apparent. The deep UV is absorbed in the cornea or eye fluids; focused VIS and NUV can damage the retina. Normal blink reaction to visible light may not be adequate protection, and a beam of invisible NUV (produced by spectral filtering) can be most dangerous as the blink response is not induced.

UV radiation can also cause painful sunburn, and with prolonged exposure, serious burns.

Recommendations

- 1 Never look directly into the output beam from the lamp housing.
- 2 Do not look at the specular (mirror) reflection of the beam.
- 3 Always wear UV protective eyewear or face mask, and adequate protection for exposed areas of skin.

II.2 LAMP EXPLOSION

When Xenon and Mercury (Xenon) arc lamps are cold, they are under several atmospheres of pressure and may explode due to internal strains or physical abuse. When hot, all lamps are under a pressure of approximately 100 atmospheres and the possibility of violent explosion exists.

Fingerprints and other contaminants left on the lamp cause a deterioration of the envelope during operation and may lead to lamp explosion.

Recommendations

- 1 Do not handle a bare arc lamp without safety goggles and adequate protection for exposed areas of skin.
- 2 Do not apply torque to the lamp envelope during installation or removal.
- 3 Do not touch the lamp envelope with your fingers.
- 4 Thoroughly clean the envelope after installation in the housing with alcohol or a dilute solution of detergent and water.

II.3 OZONE

Ultraviolet light can photo decompose molecular oxygen with subsequent formation of O₃ - Ozone. Relatively low concentrations of ozone can cause nasal dryness and a burning sensation in the throat, headaches, nausea, and irritation of the mucous membranes.

A 150 W UV arc lamp can contribute more than 1 part ozone per million to the cooling air system. This may be of little consequence in a well ventilated area but some people are very sensitive to ozone and the long term effects are not well documented. Noticeable symptoms for most people appear at around 0.3 - 0.5 ppm.

Recommended maximum exposures are typically:

- 0.1 ppm for 8 hour exposure
- 2 ppm or a 2 hour exposure

Recommendations

- 1 Use an ozone free lamp unless you need the shortwave UV.
- 2 Operate the Series Q Housing in a well ventilated area with sufficient make-up air.

II.4 ELECTRICAL SHOCK

High voltage cables for use with arc lamps are provided with ground leads on both sides.

Recommendations

- 1 Always connect ground leads to the lamp housing and the power supply before starting. Special screws are provided for grounding.
- 2 Never bypass or disable the safety interlock.
- 3 Keep personnel clear of all exposed terminals.
- 4 Before relamping or working on the system, disconnect input power and check the power supply voltmeter for zero voltage. Be sure that internal capacitors are fully discharged.

II.5 EMI

Ignition of an arc lamp requires high voltage/high frequency pulses. A high current dump (kHz discharge) follows. Both of these are sources of electromagnetic interference, both radiated and conducted. Good earthing and cable routing practice, and EMI shielding may be necessary to protect sensitive digital circuitry from these pulses.

Recommendations:

- 1 Start the arc lamp before powering nearby computer systems.
- 2 Keep the computer at least 6 feet away from the ignitor/power supply.
- 3 Use a different outlet and line for the computer and ignitor/power supply.

II.6 HEAT

Depending on the total wattage dissipated in the housing, the fins and convective cap on top may become very hot. The lamp also becomes very hot after several minutes of operation, and remains hot for up to 10 minutes after being shut off.

Recommendations

- 1 With the exception of the thermally insulated knobs on the base, adjustable reflector and lens focus, never touch the lamp housing when in use.
- 2 Allow the housing to cool before touching.
- 3 Do not touch the lamp for up to 10 minutes after being shut off.

III

GENERAL DESCRIPTION

The 60000 Series Q Lamp Housing is Oriel's most modular lamp housing. Fig. 3 on the following page shows the components available for the 60000 to convert it from an arc to incandescent to deuterium lamp housing. The four ports support condensers or rear reflectors. Fig. 2 on page 7 shows the various port configurations.

III.1 LAMP AND REFLECTOR ADJUSTMENTS

The location of the arc or filament changes from source to source due to normal manufacturing tolerances. The 60000 has precision independent X,Y, and Z external lamp controls to compensate for these variations. You can adjust the source 0.25 inches (6.4 mm) in any direction. Moving the source moves any subsequent image, and allows you to precisely set an image on a target.

The rear reflector assembly, model 60005, has control knobs that provide X,Y, and Z adjustments for tilt and focus. The 60005 can be ordered from Volume II.

III.2 LAMP COOLING

The Series Q uses natural convection (air) cooling. This is acoustically quiet and vibration free so the lamp output is more stable than in fan cooled housings. Openings in the bottom and top of the housing allow air to enter and circulate through the housing without excessive light leakage. The ribbed exterior improves cooling efficiency.

III.3 OPTIONAL CONDENSING LENS ASSEMBLIES

The 60000 does not come with a condenser. You can choose one of the following from Volume II:

60006	Condensing/Collimating Lens Assembly, F/1.5, UV grade fused silica
60007	Condensing/Imaging Lens Assembly, F/1.8, UV grade fused silica
60008	Condensing/Collimating Lens Assembly, F/0.85, molded Pyrex aspheric
60009	IR Condensing/Collimating Lens Assembly, F/1.1, Germanium
60076	Condensing/Collimating Lens Assembly, F/1, UV grade fused silica
60077	IR Condensing/Collimating Lens Assembly, F/1, Zinc Selenide

III.4 MOUNTING

The 60000 comes with four leveling feet. The feet allow 0.63 inch (16 mm) height adjustment. To mount directly to inch or metric optical tables, remove the feet and use the appropriate mounting holes. This puts the optical axis at 5.0 inches (127 mm) above the table. See Fig. 4 on page 13 for a dimensional diagram.

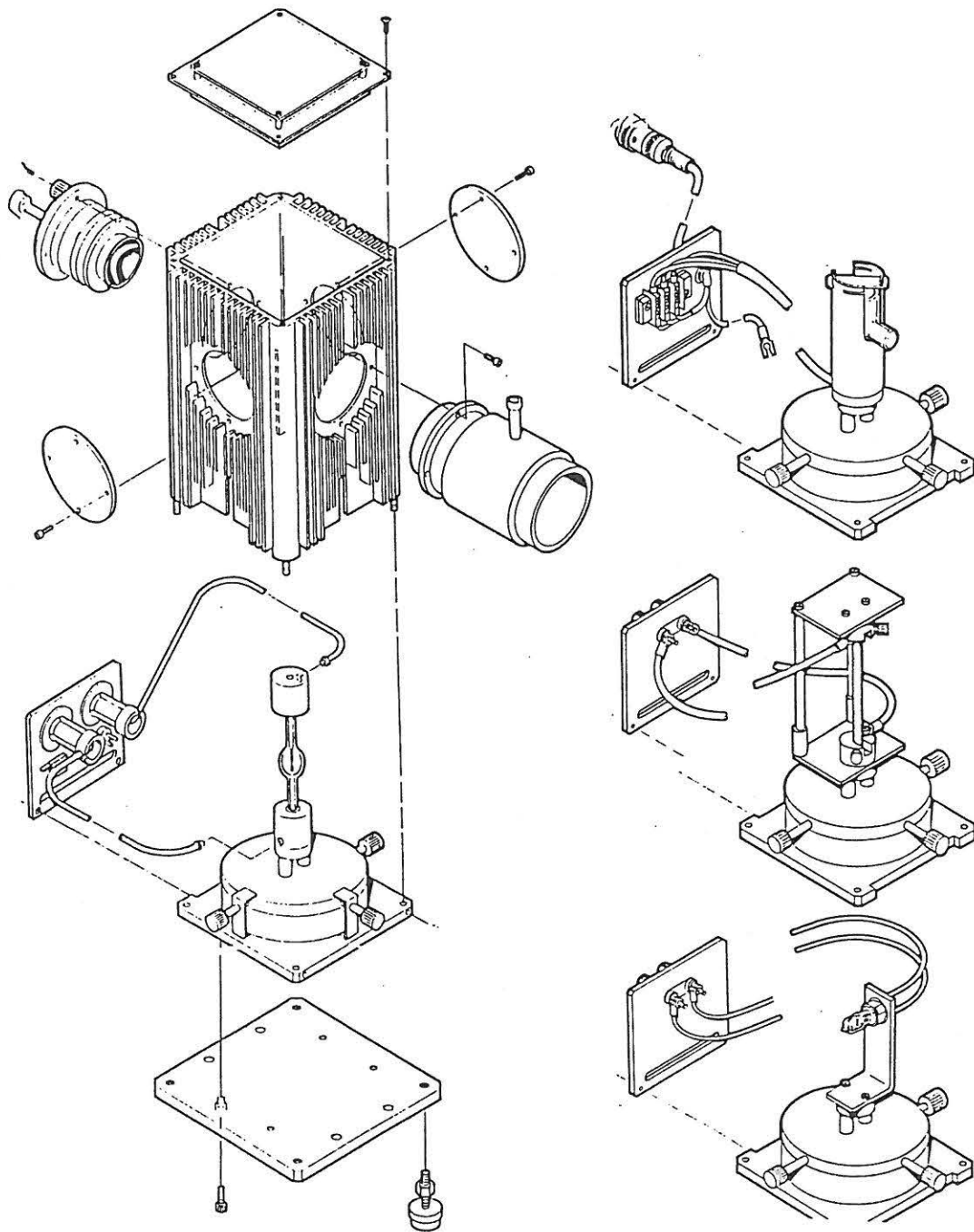


Fig. 3 Series Q Housing and components.

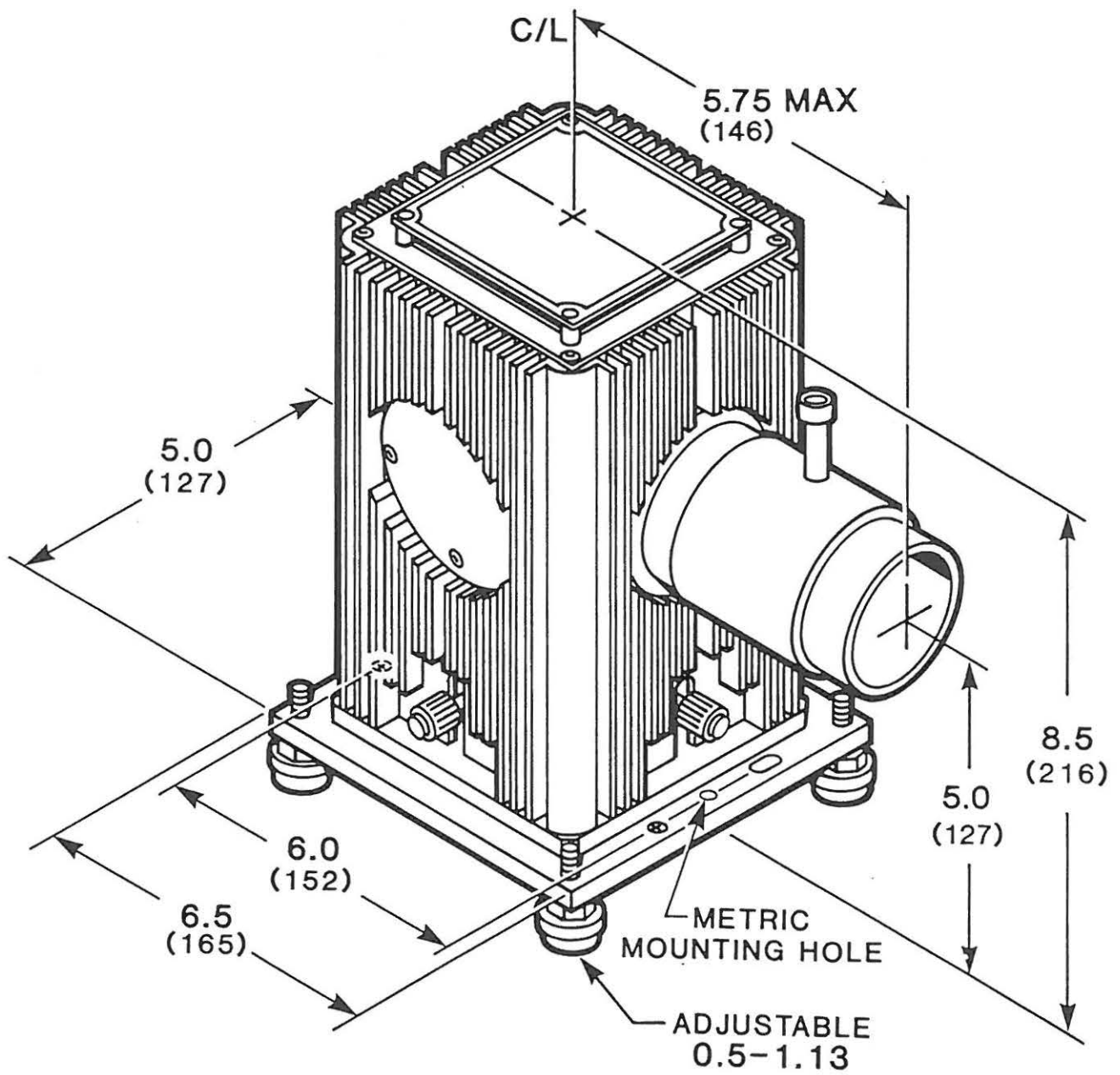


Fig. 4 Dimensional diagram.

IV

PRODUCT CONFIGURATION OPTIONS and ACCESSORIES

You can operate arc, quartz tungsten halogen, and deuterium lamps, and IR sources in the Series Q by changing interface kit and socket adapter. Table 1 on page 5 shows the appropriate kits and socket adapters for each source.

All kits have a similar interface plate to the one shown in Fig. 5 on the following page; they are mounted as follows:

- 1 Partially loosen the (4) retaining screws, #1, and remove the upper housing shell by sliding it upward.
- 2 Secure the phenolic interface plate, #2, with the (2) socket head cap screws in the recess of the base.
- 3 Follow the specific instructions supplied with each interface kit to mount the selected source and adapter to the X,Y,Z base.
- 4 Lower the upper housing shell onto the base making sure the housing opening slides onto the phenolic interface plate, and the upper shell tabs "trap" the plate.
- 5 Insert the (4) grooved studs of the upper housing shell into the base and secure it by fastening the (4) retaining screws, #1.

Cable connections from the interface kit to the power supply are covered in the Interface Kit Manuals.

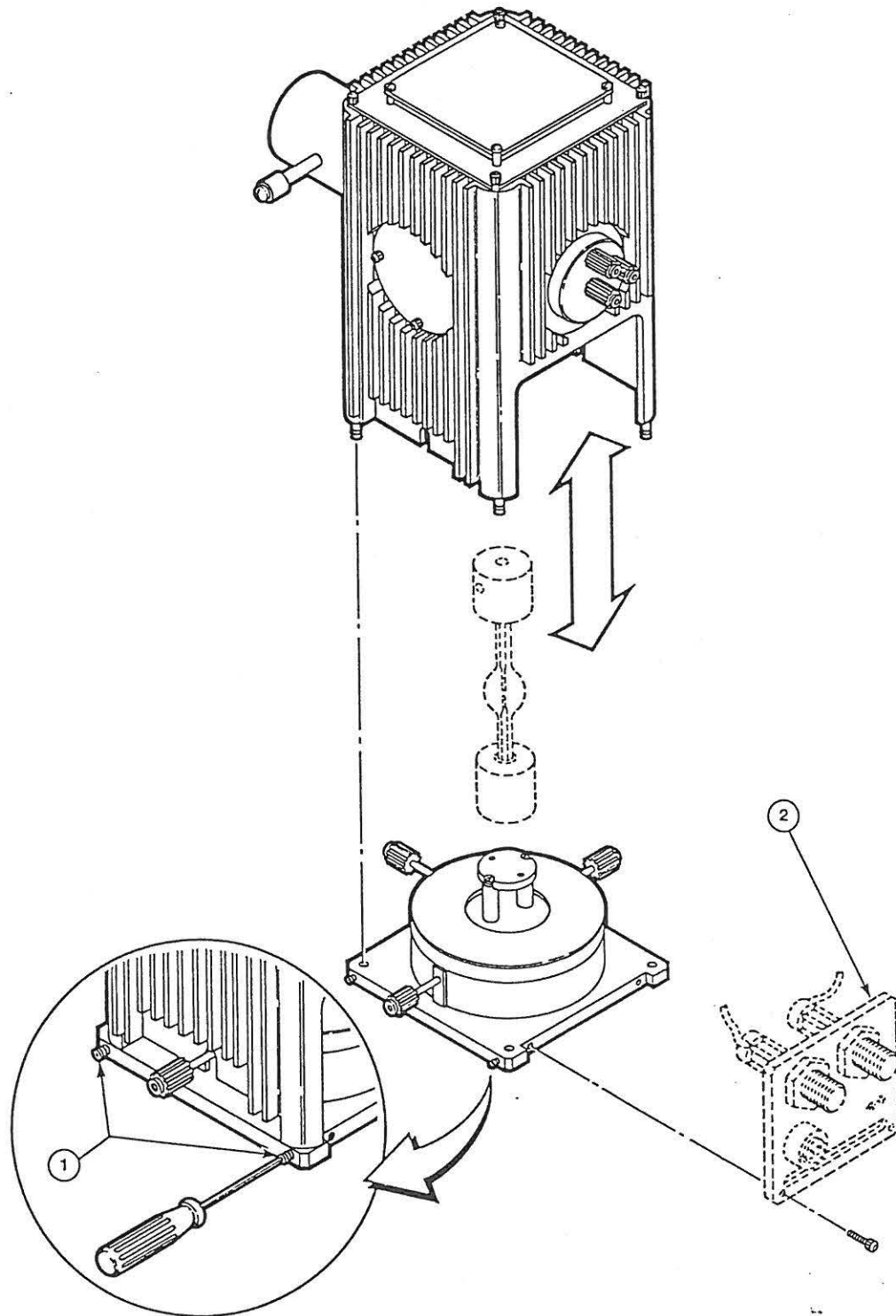


Fig. 5 Mounting Arc Lamp Interface to Series Q Housing.

V

LIGHT COLLECTION

Five different types of condensing lens assemblies are offered for the Series Q. Order them separately from Volume II. They are:

60006	F/1.5 Condensing/Collimating Lens Assembly
60007	F/1.8 Condensing/Imaging Lens Assembly
60008	F/0.85 Condensing/Collimating Lens Assembly
60009	F/1.1 Condensing/Collimating Lens Assembly
60076	F/1 Condensing/Collimating Lens Assembly, fused silica
60077	F/1 Condensing/Collimating Lens Assembly, zinc selenide

These lens assemblies are designed for efficient collection of light from the source. In order to get the best performance from the Series Q with a condenser, we first review some aspects of light collection and then describe how to set the lens position.

By moving the focusing lever on the condenser you can move the position of the condenser lenses to produce a diverging beam, "collimated beam" or to re-image the source. Most of the lens assemblies (except the 60007 F/1.8 condenser which produces a 1:1 image of the source) are designed for collimation rather than imaging. The lens shape and orientation are selected to minimize lens induced distortions (aberration) when the lenses are close to the position which produces a collimated beam (the collimating position). When you use them for imaging, there are two penalties; lens aberrations increase* and light collection is reduced. For imaging, the lens is moved further from the source, and so gathers less of the light emitted by the source within its aperture. The lens operates at a higher F/#.

*See Volume III for a comprehensive discussion on aberrations.

To simplify the discussion, we first describe the operation of an ideal lens and then some of the major results of aberrations.

V.1 COLLIMATED BEAMS

The usual concept of a collimated beam is a parallel cylinder of light. If the intensity is the same anywhere across a section of the cylinder, the beam is uniform. Unfortunately there is no source of a uniform, perfectly collimated beam.

Even expensive laser sources have some residual divergence, in the limit governed by the laws of diffraction, and they usually have non uniform though sometimes known intensity distributions.

Arc lamp sources with an ideal condenser lens in the collimating position produce beams which depend on the source size and intensity distribution.

A pinhole source at the focus of an ideal lens produces a beam which is close to the ideal collimated beam. In Fig. 6 we show a second pinhole source a distance "d" from the first.

The beam from the second pinhole will also be collimated but at an angle $\arctan(d/F)$ with the first. Any extended source can be thought of as a whole set of touching pinholes. The beam after the lens is the sum of all the beams from all the pinholes. It will contain rays with angles up to D/F where D is the largest dimension of the source. The beam will have a divergence which depends on the sum of the light from all the points on the source. Obviously this divergence will depend on the size of the source and the intensity of the various "pinholes" or points on the source.

Most arc sources are non uniform and are not circular. Therefore, the divergence in one plane is not the same as that in the orthogonal plane. For most design purposes, the arc sizes quoted in Volume II and the lens focal length give a good guide to divergence.

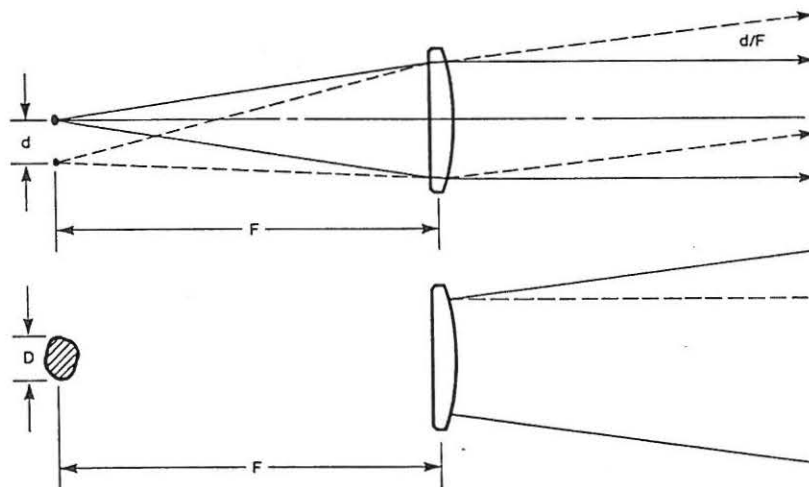


Fig. 6 For most arc sources the divergence in one plane is not the same as that in the orthogonal plane.

V.2 IMAGING THE SOURCE

You can reimage the source with one of the collimating condensers by positioning the condenser further from the source using the focusing lever. Volume III describes imaging and provides the formulae. As the condenser lens is moved out, the image moves in and becomes smaller. As already indicated, the lens collects less light as it is moved away from the source. Additionally, the convergence angle of the beam goes up as the image becomes smaller. This is not usually important for irradiance of a surface, but can be significant if the image is on the slit of a monochromator, optical fiber, or other optical system with limited acceptance angle. We normally use a secondary focusing lens to maximize the light through a slit or into a fiber optic.

Fig. 7 shows the higher convergence produced when creating a small arc image.

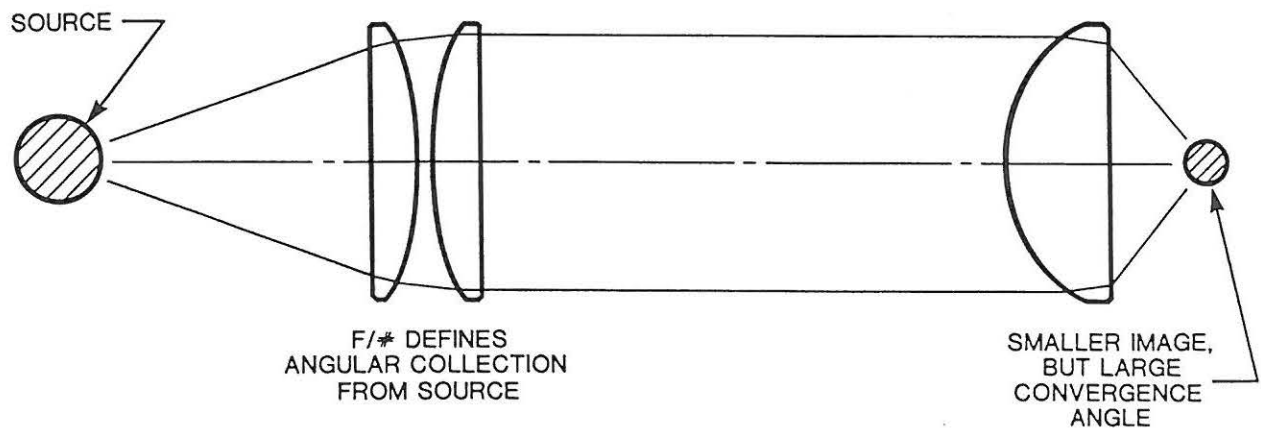


Fig. 7 A source focused to a smaller image.

V.3 REAL LENSES

The condenser lenses are intended for efficient light collection. They operate at low $F/\#$ s. As a result the single element $F/0.85$ and $F/1$ lenses suffer from severe aberrations, particularly spherical aberration. The doublet $F/1.5$ lens is somewhat better. Note that the collimated lenses perform best while collimating the light from the source.

V.3a

Spherical Aberration

This aberration results from the fact that the ideal lens, the aberration free lens, is not spherical in shape. With the exception of the aspheric ($F/0.85$) condenser, these condenser lenses, like most lenses, have spherical surface shapes for economic manufacturing. In general, spherical aberration is decreased by dividing the refraction, (light bending) as equally as possible between as many surfaces as possible. The lens shapes (plano-convex for the fused silica singlets) of our condensers and orientations minimize spherical aberration for the type of condenser and at the collimating position.

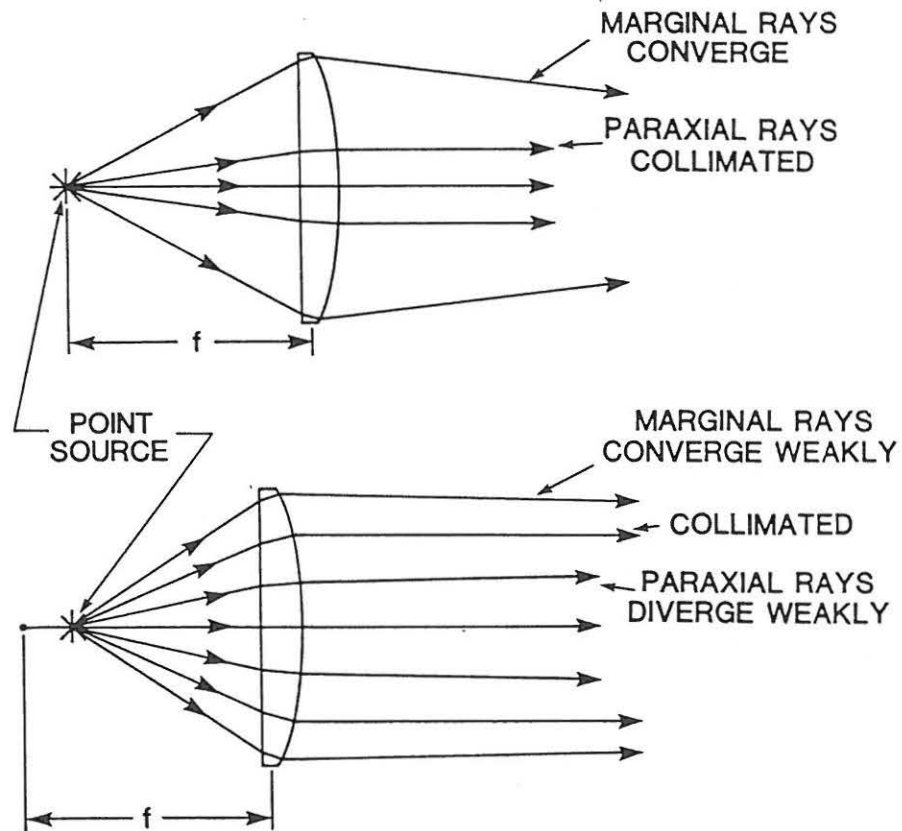


Fig. 8 The marginal rays and the paraxial rays are collimated when the point source is at the paraxial focus, and the plano surface of the lens faces the point source

Consider the simple plano convex lens collimating light from an ideal point source. With the plano surface towards the point source and the point source at the (paraxial) focus the marginal rays converge while the paraxial rays are collimated. (Fig. 8) This is due to spherical aberration. For the ideal, non spherical lens shape, the paraxial and marginal rays are all collimated. If the source is located about $1/4 f$ inside the focus, the paraxial rays diverge slightly and the marginal rays are almost collimated. This is often the optimum compromise for a single element collimating lens (and has the added advantage of collecting more light from the source).

The lens adjustment on these condensers allows the lens to be moved closer to the source than the paraxial focus. You can empirically find the best position for your system.

V.3b

Chromatic Aberration

The term "chromatic aberration" describes the variation of lens focal length with color. (Fig. 9) This variation is due to the change in lens index of refraction (n) with wavelength. As the wavelength goes up, n goes down and the focal length increases.

This causes problems in producing multi-wavelength collimated beams, but is usually a second order effect compared with source and spherical aberration limitations. Chromatic aberration usually becomes more important when UV wavelengths are to be collimated. The reduction in focal length (f) for a fused silica lens from the visible value of f to $0.91 f$ at 250 nm may require a change of lens for optimum performance. Contact Oriel for details.

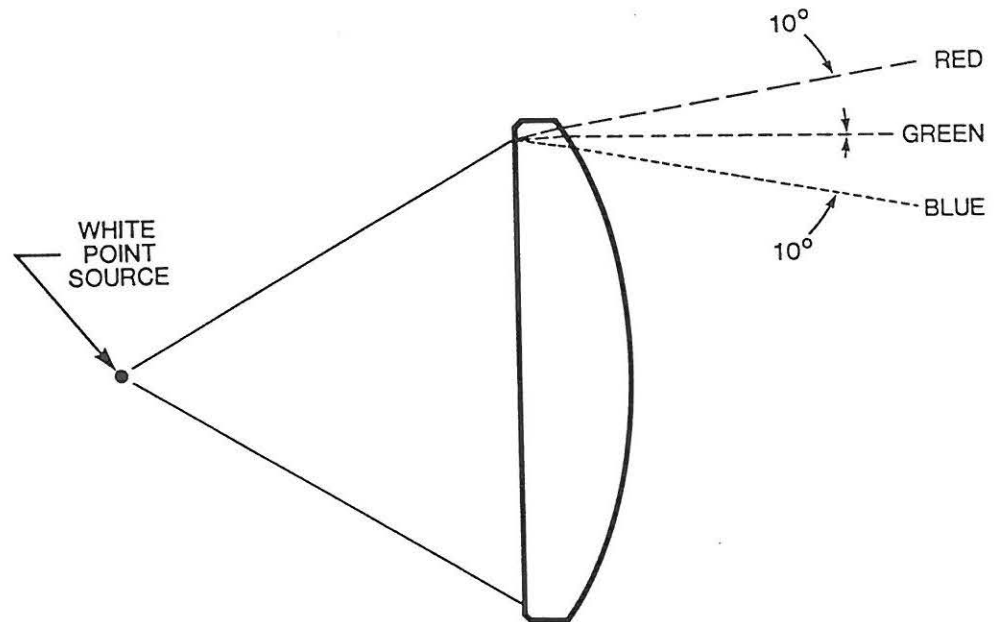


Fig. 9 Chromatic aberration: different wavelengths are focused at different points.

V.4 HOW DO YOU POSITION THE CONDENSER TO GET A COLLIMATED BEAM?

You should image the source on the most distant wall in your laboratory (remembering appropriate safety measures) to get close to the collimation position. You can then move the lens barrel in a small amount for best collimation. If your wall is 2 meters away, a 1.3 mm adjustment is required. For 3 m and 4 m, the corresponding numbers are 0.8 and 0.6 mm.

WARRANTY AND RETURNS

WARRANTY

Oriel Corporation warrants that all goods described in this manual (except consumables such as lamps, bulbs, filters, ellipses, etc.) shall be free from defects in material and workmanship. Such defects must become apparent within the following period:

1. All products described here, except spare parts: one (1) year or 3000 hours of operation, whichever comes first, after delivery of the goods to buyer.
2. Spare parts: ninety (90) days after delivery of goods to buyer.

Oriel Corporation's liability under this warranty is limited to the adjustment, repair and/or replacement of the defective part(s). During the above listed warranty period, Oriel Corporation shall provide all materials to accomplish the repaired adjustment, repair or replacement. Oriel Corporation shall provide the labor required during the above listed warranty period to adjust, repair and/or replace the defective goods at no cost to the buyer ONLY IF the defective goods are returned, freight prepaid, to an Oriel Corporation designated facility. If goods are not returned to Oriel Corporation, and user chooses to have repairs made at their premises, Oriel Corporation shall provide labor for field adjustment, repair and/or replacement at prevailing rates for field service, on a portal-to-portal basis.

Oriel Corporation shall be relieved of all obligations and liability under this warranty if:

1. The user operates the device with any accessory, equipment or part not specifically approved or manufactured or specified by Oriel Corporation unless buyer furnishes reasonable evidence that such installations were not a cause of the defect. This provision shall not apply to any accessory, equipment or part which does not affect the safe operation of the device.
2. The goods are not operated or maintained in accordance with Oriel's instructions and specifications.
3. The goods have been repaired, altered or modified by other than Oriel authorized personnel.
4. Buyer does not return the defective goods, freight prepaid, to Oriel repair facility within the applicable warranty period.

IT IS EXPRESSLY AGREED THAT THIS WARRANTY SHALL REPLACE ALL WARRANTIES OF FITNESS AND MERCHANTABILITY. BUYER HEREBY WAIVES ALL OTHER WARRANTIES, GUARANTIES, CONDITIONS OR LIABILITIES, EXPRESSED OR IMPLIED, ARISING BY LAW OR OTHERWISE, WHETHER OR NOT OCCASIONED BY ORIEL'S NEGLIGENCE.

This warranty shall not be extended, altered or varied except by a written document signed by both parties. If any portion of this agreement is invalidated, the remainder of the agreement shall remain in full force and effect.

CONSEQUENTIAL DAMAGES -

Oriel Corporation shall not be responsible for consequential damages resulting from misfunctions or malfunctions of the goods described in this manual. Oriel's total responsibility is limited to repairing or replacing the malfunctioning or malfunctioning goods under the terms and conditions of the above described warranty.

INSURANCE -

Persons receiving goods for demonstrations, demo loan, temporary use or in any manner in which title is not transferred from Oriel, shall assume full responsibility for any and all damage while in their care, custody and control. If damage occurs, unrelated to the proper and warranted use and performance of the goods, recipient of the goods accepts full responsibility for restoring the goods to their condition upon original delivery, and for assuming all costs and charges.

RETURNS

Before returning equipment to Oriel for repair, please call the Customer Service Department at (203) 377-8282. Have your purchase order number available before calling Oriel. The Customer Service Representative will give you a Return Material Authorization number (RMA). Having an RMA will shorten the time required for the repair, because it ensures that your equipment will be properly processed. Write the RMA on the returned equipment's box. Equipment returned without a RMA may be rejected by the Oriel Receiving Department. Equipment returned under warranty will be returned with no charge for the repair or shipping. Oriel will notify you of repairs not covered by warranty, with the cost of the repair, before starting the work.

Please return equipment in the original (or equivalent) packaging. You will be responsible for damage incurred from inadequate packaging, if the original packaging is not used.

Include the cables, connector caps and antistatic materials sent and/or used with the equipment, so that Oriel can verify correct operation of these accessories.